ABSTRACT

Purpose of the study: The present *in vitro* study was conducted to comparatively evaluate the effect of two different surface treatments on the bioactivity of zirconia.

Materials and Methods: 33 discs with dimensions 10mm x 2mm were obtained from zirconia blanks (AMANN GIRRBACH) and randomly divided into 3 groups (n=11), namely, Group I (Untreated), Group II (Sandblasted) and Group III (UV Photofunctionalization). Surface characteristics of representative test samples were analysed using XRD, AFM, contact angle goniometry, SEM and EDX, to assess type of crystal phase of zirconia, surface roughness, wettability, surface topography and elemental composition, respectively. Simulated Body Fluid (SBF) was prepared & Ca-content in SBF (Ca-SBF) was determined using Inductively Coupled Plasma Mass Spectrometry (ICP-MS). Test samples were incubated in SBF for 3 weeks, mean post-immersion Ca-SBF was determined for each group and representative samples were subjected to XRD and SEM-EDX analyses. Data were analysed by One-way ANOVA, Post-hoc Tukey HSD and students' paired 't' test for statistical significance ($p<0.05$ - significant; $p<0.01$ - highly significant).

Results: Surface characteristics analyses revealed: XRD showed predominant tetragonal (t) zirconia crystal phase for all test groups. Mean surface roughness (Sa) of Group I was 41.83 nm and it was significantly lesser than that of Group II (115.65 nm) and Group III (102.43nm). Mean contact angles were 98.26°, 86.77° and 68.03° for Groups I, II and III respectively and these differences were highly significant. SEM revealed relatively flat surface for Group I, irregularly roughened surface for Group II and a homogenously roughened surface for Group III. EDX

revealed elemental composition of Zr, O_2, Y, Hf, and Al for all test groups. Mean pre-immersion Ca-content in SBF was found to be 159 mg/L. Mean post-immersion Ca-content was 70.10mg/L, 60.80mg/L & 56.20 mg/L, for Groups I, II and III respectively. Significantly high depletion in Ca-content was found for all three test groups as compared to the pre-immersion value. Significant differences were found between Group I as compared to both Groups II and III. Bioactivity of Group III was marginally, but insignificantly higher with respect to Group II. Post-immersion XRD revealed predominant 't' phase and SEM-EDX revealed well-formed, abundant calcium apatite layer on the treated samples as compared to that on untreated sample and an increasing Ca/P ratio from 1.15, 1.79 to 2.08, respectively from Group I to Group III.

Conclusion: Within the limitations of the present study, both sandblasting and UV Photofunctionalization significantly and similarly improved bioactivity of zirconia as compared to the untreated samples, which was corroborated by the SEM-EDX results.

Key words: **Zirconia, surface treatment, sandblasting, UVP, SBF, Bioactivity.**